

diffraction pattern, under the same conditions, and thus allegedly anticipates the claimed invention.

Applicants respectfully traverse the rejection. The presently claimed invention is drawn to a process for producing alkyl aromatic compounds by contacting at least one aromatic compound with at least one (trans) alkylating agent as claimed in the presence of a (trans) alkylation catalyst wherein the catalyst is a **binder-free** molecular sieve with an X-ray diffraction pattern than includes the lines set forth in Table A of the specification. The term "binder-free" as defined in the specification, page 11, lines 32 - 34, describes the synthetic porous crystalline material or molecular sieve as being substantially free or free of binder materials such as clays or metal oxides, i.e., alumina or silica. In other words, the molecular sieve catalyst of the present invention is **self-bound** instead of being bound to an alumina or silica or clay binder. The presence of this self-bound or binder-free catalyst results in unexpected improvements in the claimed process.

In contrast, Kushnerick does not teach or suggest a binder-free catalyst. To properly anticipate a claim, a single reference must contain all of the elements of the claim. *See Hybritech Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1379, 231 U.S.P.Q. 81, 90 (Fed. Cir. 1986). Kushnerick discusses MCM-22, the preferred molecular sieve/zeolite material of the present invention, but only actually discloses catalysts containing zeolites bound to  $Al_2O_3$  (see example 15, col. 15-16). No catalysts without binders are described or even suggested. Further, Kushnerick teaches that the use of binders is preferred (see col. 9, lines 35-42).

Because Kushnerick neither teaches nor suggests the binder-free catalyst of the present claims, it is not a proper reference under 35 U.S.C. § 102(b). Accordingly, Applicants respectfully request that the rejection be withdrawn.

### **Rejection Under 35 U.S.C. § 103**

The Examiner has rejected claims 1-10 under 35 U.S.C. § 103(a) as being unpatentable over Kushnerick et al. According to the Examiner, the reference teaches the same process with the same MCM-22 catalyst having the same diffraction pattern, under the same conditions, and its catalyst may optionally contain a binder to increase the crush-strength thereof. The Examiner admits that a distinction may be made between the two catalyst compositions in that the reference catalyst may comprise a binder while the instant claims recite a binder-free catalyst. In the Examiner's view, however, the invention as a whole would have been obvious to one of ordinary skill in the art since "the artisan equipped with the reference teachings would select either one of two alternatives, i.e., with and without binder in the reference." The Examiner further states that "the omission of means (the binder) together with its function (enhancement of crush strength) would not involve an invention."

Applicants respectfully traverse the rejection. As discussed above, the presently claimed process for producing alkyl aromatic compounds involves a binder-free molecular sieve catalyst, i.e., a catalyst which is self-bound. The presence of this self-bound or binder-free catalyst results in unexpected improvements in the claimed process. The Examiner's attention is drawn to the examples of the present specification at pages 13-24.

The results of Comparative Example 1 (preparation of catalyst comprising 65 wt% MCM-22 bound to 35 wt%  $\text{Al}_2\text{O}_3$ ) and Example 1 (preparation of binder-free MCM-22 catalyst) are shown in Table 1 on page 13. The table shows, for example, that the Alpha activity of the binder-free catalyst was 279, as compared with a value of 192 for the 65 wt% MCM-22/35 wt%  $\text{Al}_2\text{O}_3$  catalyst. Alpha activity is defined in Kushnerick at col. 11, lines 13-20, as the approximate indication of the catalytic cracking activity of the catalyst compared to a standard catalyst.

In the second set of examples, relating to liquid phase ethylbenzene synthesis, the results of which are illustrated in Figures 1 and 2 on page 15, it is shown that to achieve a constant ethylene conversion (e.g., 98%) at 220°C, the binder-free MCM-22 could be operated at 3-4 times higher throughput than the  $\text{Al}_2\text{O}_3$ -bound MCM-22. Also, at constant throughput, the binder-free MCM-22 provided a  $\geq 50^\circ\text{C}$  temperature advantage over the  $\text{Al}_2\text{O}_3$ -bound MCM-22 to achieve comparable ethylene conversions. Table 2 on page 16 shows that to achieve comparable conversion at 1.1 ethylene WHSV, the binder-free catalyst could be operated at 161°C as opposed to 220°C for the  $\text{Al}_2\text{O}_3$ -bound catalyst. To achieve comparable conversion at 220°C, the binder-free catalyst could be operated at 4.4 ethylene WHSV compared with 1.1 ethylene WHSV for the  $\text{Al}_2\text{O}_3$ -bound catalyst.

The third set of examples, including Figure 3 on page 18 and Table 3 on page 19, show similar results for liquid phase cumene synthesis, i.e., the binder-free catalyst could be operated at more than double (100 v. 40) the propylene WHSV of the  $\text{Al}_2\text{O}_3$ -bound catalyst at 130°C average reactor temperature to achieve a constant (e.g. 96%) propylene

conversion. When operated at 130°C and 40 propylene WHSV, the binder-free MCM-22 offered 3% higher propylene conversion.

In the fourth set of examples, Figure 4 (page 21) compares catalyst performance for liquid phase ethylbenzene synthesis via benzene/polyethylbenzene transalkylation. The binder-free MCM-22 was shown to be significantly more active than the Al<sub>2</sub>O<sub>3</sub>-bound MCM-22. Further, Table 4 illustrates that when operated at 5 total WHSV, the binder-free MCM-22 gave about 3 times higher diethylbenzene, butylbenzene, and triethylbenzene conversions than Al<sub>2</sub>O<sub>3</sub>-bound MCM-22. At these higher conversions, the binder-free MCM-22 provided 3% higher ethylbenzene selectivity than the Al<sub>2</sub>O<sub>3</sub>-bound MCM-22.

The fifth set of examples again shows operation of binder-free MCM-22 at lower temperatures for a higher conversion rate.

The above results of the presently claimed process were unexpected and surprising. One of ordinary skill in the art would not have expected such drastic improvements simply by using a binder-free catalyst, particularly when Kushnerick specifically teaches the advantage of having binders in its catalyst to increase the crush-strength thereof. As argued above, Kushnerick does not teach or suggest a binder-free catalyst. In fact, although Kushnerick discusses MCM-22 at length, only catalysts with binders are actually disclosed. No catalysts without binders are even suggested in Kushnerick. Thus, contrary to the Examiner's allegation, it would not have been obvious to select one of two alternatives, i.e., catalysts with or without a binder.

Finally, the Examiner's argument that the omission of the binder together with its function of enhancing the crush strength would not be inventive is incorrect. The unexpected superiority of the claimed process has been shown above by reference to the five sets of examples in the specification. The increased efficiency and other advantages of using a binder-free catalyst in the process of the invention is clearly set forth. In light of these showings, it would not have been obvious to simply omit the binder from the process of Kushnerick to obtain the presently claimed invention. Kushnerick specifically mentions the importance of enhancing crush strength and the role of the binder in doing this. As a result, there would have been no reason for one of ordinary skill to purposely eliminate the binder from Kushnerick. Further, the present invention is drawn to a process for preparing short chain alkyl aromatic compounds wherein the process is greatly improved by the use of a binder-free catalyst. This result has nothing to do with crush strength. In fact, this surprising result goes to show that only by improper hindsight could the Examiner have come to the conclusion that it would have been obvious to take out the binder from Kushnerick's catalyst and use only a binder-free catalyst.

In light of the above, Applicants respectfully request that the rejection under 35 U.S.C. § 103(a) be withdrawn.

### Conclusion

Applicants respectfully submit that the arguments made above place this application in condition for allowance. Early and favorable action is earnestly solicited.

If there are any additional fees due in connection with the filing of this Response, such as additional fees under 37 C.F.R. §§ 1.16 or 1.17, please charge the additional fees to MOBIL OIL CORPORATION DEPOSIT ACCOUNT NO. 19-3150. If an extension of time is necessary that is not accounted for in the papers filed herewith, Applicants respectfully request an extension. The additional extension fee also should be charged to Deposit Account No. 19-3150. Any overpayment may be credited to Deposit Account No. 19-3150.

Respectfully submitted,

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